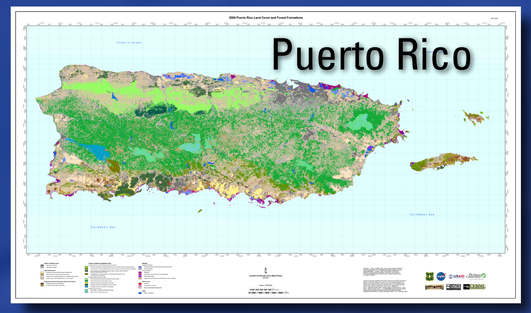
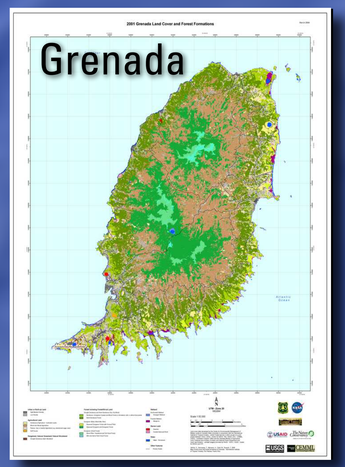
Forest Formation and Land Cover Map Series: Caribbean Islands

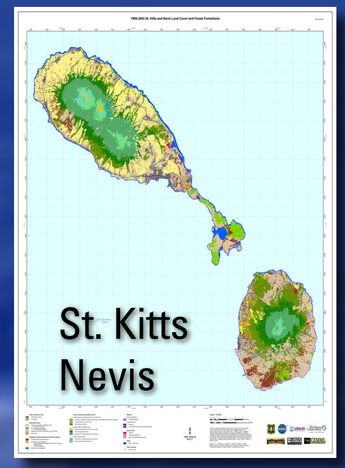
E. H. HELMER[1], S. SCHILL[2], D. H. R. PEDREROS[3], L. L. TIESZEN[3], T. KENNAWAY[4], W. M. CUSHING[3], AND T. RUZYCKI[4]

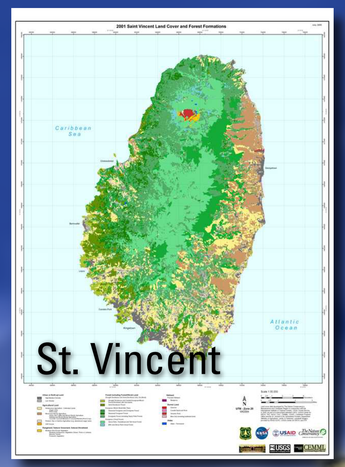
[1]*International Institute of Tropical Forestry, USDA Forest Service, Jardín Botánico Sur, 1201 Calle Ceiba, Río Piedras, Puerto Rico 00926 USA. ehelmer@fs.fed.us*
[2]*The Nature Conservancy, Mesoamerica & Caribbean Science Program, P.O. Box 230-1225, Plaza Mayor, San Jose, Costa Rica*
[3]*USGS Center for EROS, 47914 252nd Street, US Geological Survey, Sioux Falls, SD 57198 USA*
[4]*Center for Environmental Management of Military Lands, Colorado State University, Fort Collins, CO 80523 USA*

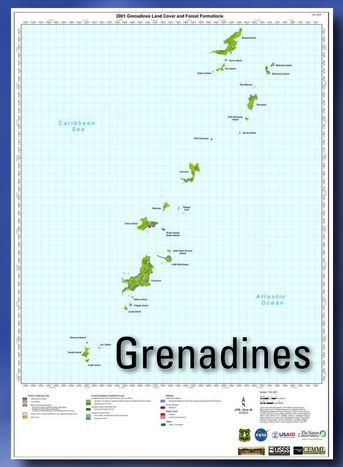


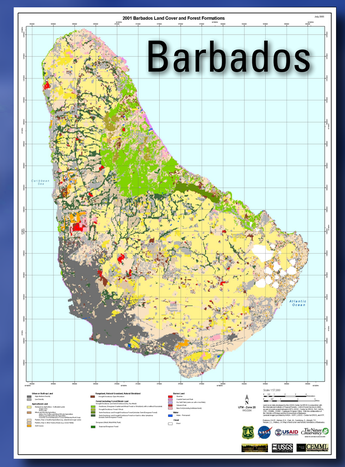


St. Kitts
Nevis









St. Lucia

St. Vincent

Grenadines

Barbados

Grenada

ABSTRACT

Forest formation and land cover maps for several Caribbean islands were developed from Landsat ETM+ imagery as part of a multi-organizational project. We used decision tree classification methods to classify the Landsat imagery for Puerto Rico (including Vieques and Culebra) (1), St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Grenada. Land cover and forest formations underneath clouded areas in the Landsat imagery for large portions of St. Lucia, St. Vincent and the Grenadines, and the entire island of Barbados were manually delineated using IKONOS imagery. The woody vegetation classification scheme relates closely to that of Areces-Malea et al. (2), who classify Caribbean vegetation according to standards of the US Federal Geographic Data Committee (FGDC, 1997), with modifications similar to those in Helmer et al. (3). The decision trees classified a stack of raster layers for each mapping area that included the Landsat image bands and various ancillary raster data layers. For Puerto Rico, for example, the ancillary data included climate parameters (4). For some islands, the ancillary data included SRTM (5) or other topography and topographic derivatives such as aspect, slope and slope position. We also developed mostly cloud-free image mosaics with regression tree normalization (6), including mosaics for wet and drought seasons for several of the islands.

The map of the Dominican Republic (DR) (7) was developed by the DR Department of Environment and Natural Resources. They manually interpreted the land cover classes for the Dominican Republic and did not use rule-based methods. Woody vegetation classes in the original map for the DR corresponded to those of Tolentino and Peña (8). They included two conifer cover classes, four climatic zone classes of broadleaved forests, and two shrubland classes. These classifications were cross-walked to match the classes on other islands using surficial geology and techniques described in Helmer et al. (3).

On the islands where it was used, the process of using decision tree classifiers along with ancillary geospatial data accurately distinguished spectrally similar forest formations without the aid of ecological zone maps. Although the decision tree classifiers accommodated spectrally heterogeneous classes, the regression tree modeling techniques to fill cloud gaps produced mosaics of cloud-free images that were easier to visually interpret, which aided training data collection. For several of the islands, the use of multiseason imagery enhanced land cover classification accuracy by facilitating separation between classes such as semi-deciduous forest (including semi-evergreen forest) and drought deciduous forest/woodland.

REFERENCES

1. T. Kennaway, E. H. Helmer. (Intl Inst of Tropical Forestry, USDA Forest Service, Río Piedras, Puerto Rico, 2006).
2. A. Areces-Mallea et al., "A guide to Caribbean vegetation types: classification systems and descriptions" (The Nature Conservancy, 1999).
3. E. H. Helmer, O. Ramos, T. Lopez, M. Quiñones, W. Diaz, Carib J Sci 38, 165-183 (2002).
4. C. Daly, E. H. Helmer, M. Quiñones, Int J Climatology 23, 1359-1381 (2003).
5. T. G. Farr, M. Kobrick, Eos Transactions 81, 583-585 (2000).
6. E. H. Helmer, B. Ruefenacht, Photogrammetric Eng Rem Sens 71, 1079-1089 (2005).
7. S. Hernández, M. Pérez. (Secretaría de Estado de Medio Ambiente y Recursos Naturales de la República Dominicana, Santo Domingo, Dominican Republic, 2005).
8. L. Tolentino, M. Peña, Moscosoa 10, 179-203 (1998).

COOPERATING INSTITUTIONS

USAID was a major contributor to funding for this work. The NASA Global Observation of Forest Cover program provided most of the Landsat ETM+ imagery. Other cooperating institutions include the following: Secretaría de Estado de Medio Ambiente y Recursos Naturales de la República Dominicana, St. Kitts Departments of Agriculture and Physical Planning, Nevis Departments of Agriculture and Physical Planning, St. Lucia Forestry Department, St. Vincent and the Grenadines Forestry Department, Grenada Forestry and National Parks Department and Land Use Division, and the Barbados Ministry of Energy and Environment.

CONTRIBUTORS

Matthew Clark, Rebecca Rock, Santiago Hernández, Mariana Pérez, Tom P. Albright, Humfredo Marcano, Cornelius Isaac, Michael Mason, Anthony Jeremiah, Patrick Williams, Floyd Liburd, Rene Walters, Quincy Alexander, Eric Van Praag, Sean Carrington, and John Walkey.

DATA AVAILABILITY

These land cover data and cartographic products will be available for download as soon as peer review is completed. Please check the following websites in the near future: USGS Center for EROS - International Programs (http://edcintl.cr.usgs.gov) and US Forest Service International Institute of Tropical Forestry (http://www.fs.fed.us/global/iitf/).